BE-01

THE DEVELOPMENT OF INQUIRY BASED VERTEBRATE ZOOLOGY PRACTICUM GUIDANCE TO INCREASE COGNITIVE AND PROCESS SKILL OF BIOLOGY STUDENTS

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Abstract

The study was a Research and Development that was conducted to produce a valid, practical, and effective Inquiry-based Vertebrate Zoology Practicum Guidance. The study was conducted at Biology Laboratory in Mathematics and Natural Science Faculty of Universitas Negeri Makassar. The subjects were students in Class Biology Science (n=33) as second semester students in academic year 2012/2013. The development of practicum guidance in this study referred to Dick & Carey's Development Model which consists of 10 stages as follows: (1) Identify Instructional Goals, (2) Conduct Goal Analysis, (3) Identify Entry Behaviours and Characteristics, (4) Write Performance Objectives, (5) Develop Criteria-Referenced Test Items, (6) Develop Instructional Strategy, (7) Develop and Select Instructional Materials; (8) Design and Conduct Formative Evaluation; (9) Design and Conduct summative Evaluation, and (10) Revise Instructional process. The product that had been developed then processed with analysis of validity, practicality, and effectiveness. Based on the result of analysis, Inquiry-Based Vertebrate Zoology Practicum Guidance which had been developed was found to be valid, practical, and effective. Validation result showed that the practicum guidance was included in valid category with validation value of 4.19. The practicality were measured by using observation sheet of practicum guidance feasibility, and the result showed that the aspect of syntax was included in medium category, social interaction in very high category, and reaction principle in high category. Meanwhile, effectiveness of the practicum guidance were measured by using student's activity observation sheet and practicum final test, the result showed that the average percentage of practicum time is in accordance with the percentage of ideal time and tolerance intervals time. The percentage of students who can pass vertebrate zoology practicum test and final course test is 96.97% and 89.19%, respectively.

Keywords: Inquiry, Practicum Guidance, Vertebrate Zoology

INTRODUCTION

The development of science and technology creates a more competitive environment which force people to improve their quality thoroughly. Educational institusions have a significant role in supporting comprehensive improvement of student, which comprises cognitive aspect (thinking skill), psychomotor (skill to do work), and affective aspect (behaviour of learner). In fact, each students has an unequal ability of the three aspects. Muhajir (2012) stated that each student has a different level of cognitive, affective, and psychomotor capability.

Psychologically, there are learners who have a high ability to think (cognitive skill) and behave very well (affective skill), but their skill to do work (psychomotor) is rather low. Vice versa, there are learners who have high psychomotor and affective skill, but they have a low level of cognitive skill.

The efforts to balance the cognitive, affective, and psychomotor skill of student is the demands of competence-oriented curriculum in order to achieve the improvement of the students quality. One of the efforts to balance student's cognitive, affective, and psychomotor skill is through practicum activity, since it provides the opportunity for students to do inquiry. Wilson and Murdoch (2007) explained that "Inquiry-based Learning involves students forming their own questions about a topic and having time to explore the answers. The students are both problems posers and problem solvers within inquiry learning. If implemented with the student as a central player in the decision making process, the pace, content, and skill development can be better match the needs of the learner". Through inquiry activity, the students are trained to solve problems in their environment. Accordingly, inquiry learning can support the effort to improve student's skills in the respect of current demands in their environment.

Unfortunately, practicum activity in Biology learning have not developed inquiry based learning optimally. Generally, students conducted practicum activities based on the instructions in guide book, and they are not able to summarize all the important aspects of practicum which have been conducted (Lunetta, 1998). Parkinson (2004) also stated that practicum activities consist of the list of work procedures which carry wrong information to students about natural sciences.

According to Accus (2007) in Supriyatin et al. (2011), this condition is caused by several things, such as the practicum activity which had been conducted is a direct instruction with lectrurer centered activities. In general, the lecturer is difficult to change the practicum activities which is direct instructional into inquiry-based practicum activities. Consequently, during practicum activities, students only focus on standard procedures in guide book, not on the basic idea or concept. The practicum activities which were conducted also did not give the opportunity for students to think independently and to build their own knowledge. Supriyatin et al., (2011) argued that such a condition occurs because of the traditional procedure of practicum activities in which the purposes, procedures and activities were specified by the lecturer in the form of student worksheets or guide book. Accordingly, a lot of research that combines laboratory activities with other teaching methods had been conducted to overcome such a condition (Wallace, Tsoi, Calkin, & Darley, 2003). Nakhleh et al. (2002) suggested that teachers use inquiry-oriented labs, allow students to give open questions, and make the lab as a link with what is happening in the outside world and the latest knowledge (Ketpichainarong, Bhinyo, and Pintip, 2010). Thus, students will have the opportunity to develop cognitive, affective, and psychomotor abilities equally.

Practicum activities in Biology Department of Makassar State University has not been implemented based on the principles of inquiry learning, particularly vertebrate zoology practicum activities. It is because the vertebrate zoology guide book still in its traditional design, where the purposes, procedures, and practicum activities have been determined. Consequently, it is difficult for students to get the opportunity to do exploration during practicum activities. Students only carry out practicum activities in accordance with the sequence of steps that had been written in guide book. This ultimately led to a low level of student's understanding of vertebrate zoology material.

Vertebrate Zoology practicum activity is part of Vertebrate Zoology course since it was included in the Vertebrate Zoology Semester Credit Units (SCU) of lectures. Practicum activities in this case serve to support theory given by the lecturer during the lecture. To overcome the limitations of students in developing an understanding of vertebrate zoology material, the researchers tried to develop an inquiry based vertebrate zoology practicum guide to

facilitate students to understand the morphology, anatomy, and functions (organ system) of each specimen during practicum activities. Inquiry based vertebrate zoology practicum guide is expected to have validity, practicality, and effectiveness in helping students to build a comprehensive understanding of vertebrate zoology material.

Some of the points that will be the extent of the problem to be studied is, how the process of development, validity, practicality, and effectiveness of Inquiry-based Vertebrate Zoology practical guide to be used during Vertebrate Zoology course in Department of Biology, Mathematic and Natural Science Faculty, Makassar State University. The study aimed to develop an inquiry based vertebrate zoology practicum guide with a good quality (valid, practical, and effective) which will be used to support the vertebrate zoology course. The practicum guide can be the guidance in conducting vertebarate zoology practicum and be able to improve student's motivation to understand the concepts of vertebrate zoology.

RESEARCH METHOD

The type, location, and research subject

The Study was a research and development. The final product of the study was a practicum guide of Inquiry-based Zoology Vertebrae Practicum Guide which was processed with analysis of needs, practicality, and effectiveness. The study was conducted at Biology Laboratory of Mathematics and Natural Science Faculty in Universitas Negeri Makassar. The subject of the study was Class Biology Science as biology student at the second semester in academic year 2012/2013.

Learning Tool Development Procedure

The development of practicum guide that is used in this research refers to Dick & Carey development model which was developed by Walter Dick & Lou Carey (1990). It consists of ten (10) stages of development, namely: (1) Identify Instructional Goals, (2) Conduct Goal Analysis, (3) Identify Entry Behaviours and Characteristics, (4) Write Performance Objectives, (5) Develop Criteria-Referenced Test Items, (6) Develop Instructional Strategy, (7) Develop and Select Instructional Materials, (8) Design and Conduct Formative Evaluation, (9) Design and Conduct summative Evaluation, and (10) Revise Instructional process.

Research Tools and Instruments

This study used the device as well as the instruments to measure the practicality and effectiveness of the device which was developed. The device which was developed is Inquiry-based Vertebrate Zoology Practicum Guide which is valid, practical, and effective along with other supporting instruments which included observation sheet of practicum guide implementation, apprentice activity, and practicum final test.

Data Analysis Techniques

Descriptive statistical analysis techniques was used to analyze the data obtained in the development of this practicum guide. The data analyzed were the validation result of practicum guide, the implementation level of practicum guide, student's activities during practicum, and the data of practicum final test. Analysis of the data obtained are classified into 3 (three), namely: (1) analysis of data validity (data of practicum guide validation result), (2) analysis of data practicality (observed data of practicum guide feasibility), and (3) analysis of data effectiveness (observed data on the activities of the apprentice, performance assessment, and practicum final tests).

RESULT AND DISCUSSION

Validity Of Inquiry-Based Vertebrate Zoology Practicum Guide

The research instruments can be considered as valid if all the aspects of the research tools and instruments supporting the research at least in the category of valid enough and if each aspect of the research tools and instruments supporting research at least in the category of valid. The following discussion will discuss how valid the supporting research tools and instruments are.

Research instrument in this study is Inquiry-based Vertebrate Zoology Practicum Guide. Supporting instruments are observation sheets of practicum guide feasibility and practicum guide practicality. Those observation sheets were used to measure the practicality of practicum guide. The other supporting instument is used to measure the effectiveness of practicum guide, which consists of apprentice activity observation sheet and practicum test result.

Inquiry-based Vertebrate Zoology Practicum Guide

Tabel 1. Validation result of Inquiry-based Vertebrate Zoology Practicum Guide

No	Aspects	$\bar{x}$	Category
1.	Format	4,20	Valid
2.	Language	4,38	Valid
3.	Content	4,00	Valid
	Average	4,19	Valid

Table 1 shows validation value of all aspects which were assessed in Inquiry-Based Vertebrate Zoology Practicum Guide, that is 4.19 which is included in valid category. Based on the data above, it is known that all aspects of research instrument are included in the category of valid, then the Inquiry-based Vertebrate Zoology Practicum Guide as the research instrument is declared as valid.

Observation Sheet of Practicum Guide Feasibility

Table 2. Validation Result of Practicum Guide Feasibility Observation Sheet

No	Aspect	$\bar{x}$	Category
1.	Objective	4,25	Valid
2.	Practicum activity range	3,67	Valid
3.	Language	4,33	Valid
	Average	4,08	Valid

Table 2 shows validation value of all aspects which were assessed in Practicum Guide Feasibility Observation Sheet, that is 4.08 which is included in valid category. Based on the data above, it is known that all aspects of research instrument were included in the category of valid, then the Practicum Guide Feasibility Observation Sheet as the research instrument is declared as valid.

Student Activity Observation Sheet

Tabel 3. Validation Result of Studen Activity Observation Sheet

No	Aspect	$\bar{x}$	Category
1.	Direction	4,17	Valid
2.	Language	4,38	Valid
3.	Content	4,13	Valid
	Average	4,22	Valid

Table 3 shows validation value of all aspects which were assessed in Student Activity Observation Sheet, that is 4.22 which is included in valid category. Based on the data above, it is known that all aspects of research instrument were included in the category of valid, then the Student Activity Observation Sheet as the research instrument is declared as valid.

Practicum Final Test

Table 4. Validation Result of Practicum Final Test

No	Aspect	$\bar{x}$	Category
1.	Content	4,50	Very Valid
2.	Language	4,50	Very Valid
3.	Time	4,50	Very Valid
	Average	4,50	Very Valid

Table 4 shows validation value of all aspects which were assessed in Practicum Final Test, that is 4.50 which is included in very valid category. Based on the data above, it is known that all aspects of research instrument were included in the category of very valid, then the Practicum Final Test as the research instrument is declared as valid.

Practicality Of Inquiry-Based Vertebrate Zoology Practicum Instrument

Practicality of Inquiry-based Vertebrate Zoology Practicum Guide were measured by using a Practicum Guide Feasibility Observation Sheet as the research instrument. Aspects which will be observed in the Practicum Guide Feasibility Observation Sheet are aspects of syntax, social interaction, and reaction principles.

Aspect of Syntax

Based on the observations of four (4) meetings, the average of total syntax aspect on practicum guide feasibility observation sheet is 2.92 (two point two nine). Based on feasibility category of each aspect, the feasibility of the practicum guide is M>2 which means that all the activities were conducted (Nurdin, 2007), then the overall syntax of inquiry-based vertebrate zoology practicum guide were conducted. Agreement percentage on syntax aspect of practicum guide feasibility observation sheet is 0.60 (zero point six zero). Based on category of reliability coefficient (Guilford, 1956: 145 in BAPM, 2008), $0{,}40 < r11 < 0{,}60$ is included in medium reliability, then the syntax aspect of Inquiry-based Vertebrate Zoology Practical Guide is declared as Reliable.

Aspect of Social Interaction

Based on the observations of four (4) meetings, the average of total social interaction aspects on practicum guide feasibility observation sheet is 3.46 (three point four six). Based on the category of feasibility of each aspect or the whole aspects, the feasibility of the practicum guide is M>2 which means all the activities were conducted (Nurdin, 2007), then the overall social interaction aspect of inquiry-based vertebrate zoology practicum guide were conducted. Agreement percentage on social interaction aspect of practicum guide feasibility observation sheet is 0.88 (zero point eight eight). Based on category of reliability coefficient (Guilford, 1956: 145 in BAPM, 2008), $0{,}80 < r11 < 1{,}00$ is included in very high reliability, then the social interaction aspect of Inquiry-based Vertebrate Zoology Practical Guide is declared as Reliable.

Aspect of reaction principal

Based on the explanation above, the total average of all aspects (syntax, social

interaction, and reaction principle aspect) of 4 (four) meetings on Practicum Guide Feasibility Observation Sheet is 3.24 (three point two four). Based on the category of feasibility of the whole aspects, the feasibility of the practicum guide is M>2 which means all the activities were conducted (Nurdin, 2007), then the total average of all aspect of inquiry-based vertebrate zoology practicum guide were fully conducted. The total average of agreement percentage of all aspect on the Practicum Guide Feasibility Observation Sheet is 0.77 (zero point seven seven). Based on category of reliability coefficient (Guilford, 1956: 145 in BAPM, 2008), 0,60 < r11 < 0,80 is included in high reliability, then the total average of all aspects on the Practicum Guide Feasibility Observation Sheet is declared as Reliable.

The effectiveness of Inquiry-Based Vertebrate Zoology Practicum Guide

The effectiveness of Inquiry-based Vertebrate Zoology Practicum Guide in this study was measured by using Apprentice Activity Observation Sheet and Practicum Test as research instruments.

Apprentice Activity Observation Sheet During Practicum

Based on the observation of three observers in each group, it can be seen that the time used by all the groups for practicum actvity is agree with the ideal time given. The time used by Group III is the closest to the ideal time, it can be seen from the first until the fourth meeting, they had implemented the practicum activity based on inquiry syntax which is contained in Inquiry-based vertebrate zoology practicum guide. This shows that the apprentice activity during practicum activity which implement inquiry-based vertebrate zoology practicum guide were mostly done.

Practicum Test

Practicum value was obtained from the analysis of activity score during practicum and final exam score which was undertaken by the Coordinator Assistant of Vertebrate Zoology Practicum. Students of Biology Department class science who pass the practicum test are 32 (thirty two) with the percentage of 96.97 students, and students who failed is 1 (one) student with the percentage of 3.03. The minimum score to pass the final exam is 60 (sixty).

Inquiry-based Vertebrate Zoology Practical Guide that have been applied was able to improve cognition and skills of the students in the course of Vertebrate Zoology as evidenced by the high percentage of students who can pass the Vertebrate Zoology practicum (96.97%) and Vertebrate Zoology course (89.19%). The findings in this study is in line with the finding of Rustaman and Rusyana (2011), who found that the development of Critical Thinking-based Invertebrate Zoology lecture program (P3ZI) excels in improving deductive/ inductive thinking skills of students (Ng = 0.47).

There are some studies that can explain the reason of the high student's achievement after implementing inquiry-based learning, such as Abdelraheem & Asan (2006), Azizmalayeri et al. (2012), Harlen (2004), and Rokhtima (2012). Abdelraheem & Asan (2006) explained that inquiry is very important in learning since it is the tool to improve student's critical thinking skill, problem solving, and creativity. It is supported by the finding of Azizmalayeri et al. (2012) that the guided inquiry teaching method had a significant effect (lower than 0.05) on the critical thinking skills of students in inferencing and drawing conclusions. Harlen (2004) in Balim (2009) explained that inquiry learning in science can develop perception skill of students since inquiry provide the opportunity for student to understand natural phenomena by using their cognitive and psychomotor skill.

The method of inquiry is believed by researchers as an effective learning instruction to improve students' understanding, because the inquiry emphasizes on student-centered activities rather than on the teacher. Mao and Chang (1998) also supports the positive role of inquiry-

based learning. They explained that the inquiry-based instruction emphasizes the interpretation of the data, group discussion, and cooperative learning to develop mental, attitude and skills of the students to be better in biological sciences.

Type of inquiry that is applied in this study is included in guided inquiry and included in the first level of inquiry. The first level of inquiry is an inquiry activity where issues raised by teachers or sourced from textbooks, students then worked to find an answer to the problem under the intensive guidance of a teacher (guided Inquiry). In guided inquiry, learning activities should be well managed by teachers and learning outcomes have been predictable from the beginning. This kind of inquiry is suitable to be applied in learning the concepts and principles underlying the particular field of science as in the field of Biological Sciences, Vertebrate Zoology courses.

CONCLUSION AND SUGGESTION

Development process of Inquiry-based Vertebrate Zoology Practicum Guide was conducted through several stages, as follows: measure the validity of Inquiry-based Vertebrate Zoology Practical Guide and research instruments. After being declared as valid, the Practicum Guide is ready to be tested. The following stage is revision. After the revision, the practicality is measured by using Apprentice Activity Observation Sheet during practicum activities which were conducted in 4 (four) meetings by 3 (three) observers. Practicum test was performed after all units in Practicum Guide had been executed entirely. Based on the data obtained by observers, the researchers analyzed the practicality of practicum guide. The result showed that the practicum guide is reliable and it had been conducted completely. Analysis results of measuring the effectiveness of the Apprentice Activity Observation Sheet showed that the average percentage of practicum time is in accordance with the percentage of ideal time and tolerance intervals time. The percentage of students who can pass vertebrate zoology practicum test and final course test is 96.97% and 89.19%, respectively. Based on the quality (validity, practicality, and effectiveness) of Vertebrate Zoology Practical Guide that have been developed through several stages as mentioned above, then the Inquiry-based Vertebrate Zoology Practicum Guide was declared as valid, practical, and effective.

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